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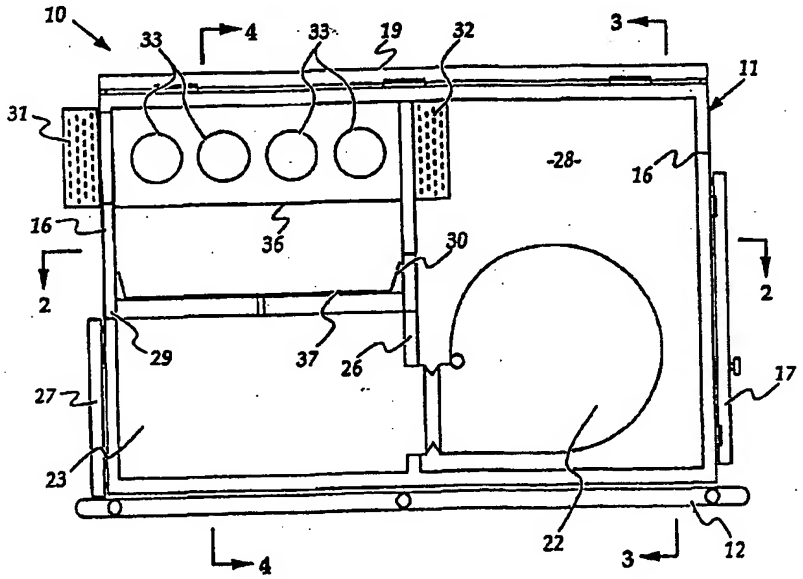

(57) Abstract

Drying apparatus (10) for drying food and the like material, said apparatus including a primary drying chamber (20) for receiving an operative quantity of material to be dried, a secondary drying chamber (21) for receiving material from the primary chamber, the secondary chamber being able to contain a plurality of operative quantities of material from the primary chamber, transfer means (50) for transferring the material from the primary chamber to the secondary chamber, supply means (22) for supplying a gaseous drying medium through the drying chambers, and heating means (33) for heating the drying medium supplied to the drying chambers. Preferably, the primary drying chamber is a fluidized bed chamber (36) and the secondary drying chamber includes a tray (30) for receiving the material from the first chamber once it has been partially dried therein.

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DRYING APPARATUS

This invention relates to drying apparatus.

This invention has particular but not exclusive application to apparatus for drying of food and particularly vegetable products, and for illustrative purposes reference will be made to such application. However it is to be understood that this invention could be used in other applications such as drying of non-food products, including plaster or clay products, textile products, timber, tobacco leaf and such like.

Drying of food products may be incorporated in the processing of foods where, for example, the food product is to be stored for an extended period of time. Food dryers typically use a closed system where the air used for drying is recycled, or alternatively, an open system where fresh air is passed across or through the food product to be dried but the air is not recycled.

The closed systems dry the product by contacting air with the product, thus humidifying the air. Moisture is removed from the air by a refrigeration system which recovers the energy from the moisture vapour and the dried air is recycled, and may be partly reheated using the energy recovered from the refrigeration system.

However, when such closed systems are in use, microbial contamination often builds up and the quality of the product may be compromised by such microbial contamination. This condition occurs because in such closed systems the moisture removed within the recirculating air path and microbial contaminants survive in the wet areas.

The open systems require large amounts of energy to heat the air passing over the food product. In the absence of air heating, the surface moisture evaporation rate is not sufficiently high to permit drying of the food product prior to its deterioration.

The present invention aims to alleviate one or more of

the above disadvantages and to provide drying apparatus which will be reliable and efficient in use.

With the foregoing in view, this invention in one aspect resides broadly in drying apparatus including:-

a primary drying chamber for receiving an operative quantity of material to be dried;

a secondary drying chamber for receiving material from said primary chamber, said secondary chamber being able to contain a plurality of operative quantities of material from said primary chamber;

transfer means for transferring the material from the primary chamber to the secondary chamber;

supply means for supplying a gaseous drying medium through said drying chambers, and

heating means for heating the drying medium supplied to said drying chambers.

Preferably, the primary drying chamber is a fluidized bed chamber and the secondary drying chamber includes a tray. Alternatively, the secondary chamber may include a plurality of trays in stacked arrangement. Solids may be agitated in the primary chamber such that fresh material is mixed with solids in the fluidized bed and an overflow of such solids from the primary stage is transported to the second stage, such as by gravity. It will be appreciated that for some material, baskets, bags or such like which may be inserted and retained in the secondary chamber for a suitable interval of time and then removed and replaced with a subsequent load of solids to be dried.

Preferably, however, the fluidized bed is charged with a batch of material to be dried, and operated for a time sufficient to remove most of the easily removed moisture and thereafter, the material is transferred from the fluidized bed to the secondary chamber prior to the primary chamber being refilled with a fresh operative quantity of material to be dried.

In use, the fluidized bed is preferably fluidized by passing the drying medium upwardly through the material to be dried and downwardly through the ssecondary chamber wherein the material is suitably supported on trays to be dried thereon.

The supply means may circulate the an air supply through the drying apparatus in any sequence, including being arranged to direct the drying medium through both drying chambers in parallel, in series, or in combination of same. Preferably, the supply means circulates the air supply from an air inlet successively through said secondary drying chamber and said primary drying chamber. Additionally, a recirculating supply path through said primary chamber may be included in the supply means.

It is preferred that some of the drying medium is recirculated to the primary chamber and that the remainder is discharged, the amount of drying medium discharged being replenished by fresh drying medium received through the fluid inlet.

The supply means may also include recovery means for recovering heat from the gaseous drying medium discharged externally of the drying chambers, and the recovery means supplying heat to the heating means. As an alternative, or in addition thereto, an external heat supply may be provided with no heat being recovered if desired. Preferably, the heating means is disposed in the air inlet to the secondary chamber.

Additionally, the supply means includes a pump for fluidizing the material in the primary chamber and preferably the inlet to the pump communicates with the secondary chamber whereby process air is received by the pump.

The secondary chamber may include a slow moving conveyor belt, the rate of movement being adjusted or adjustable to permit the plurality of operative quantities of material to be transferred thereto. Preferably, however, the secondary

drying chamber contains a plurality of holding stations for holding respective batches of material from the primary chamber. However it is achieved it is desired to maintain the material in the secondary chamber for a much longer period than the material is held in the primary chamber.

In an alternative embodiment, the primary and secondary chambers may include respective transport means for transporting material to be dried through the primary and secondary chambers respectively and if desired separate drying medium supplies. The transport means may be a screw feeder, belt or conveyor, or other solids transport apparatus passing through both drying stages. In such an arrangement, the conveyor would preferably operate at different speeds for the different stages.

It will be appreciated that an alternative arrangement may be that the drying medium is passed across the material to be dried on a non-porous tray in either the primary or secondary chamber.

In a further alternative, the drying medium may be passed upwardly through the material on the porous tray, however, as material in the second stage is approaching the desired dryness, such an arrangement is believed to be unsuitable if the dried material is buoyant in the upward draught of drying medium.

The porous tray may be substituted by a porous belt having a slow rate of travel through the drying apparatus so that solids may be dried in a continuous process. Alternatively, the belt may be kept stationary until the dried material is ready for discharge, whereupon, the belt is activated to remove the dried material from the second stage through the solids outlet.

Preferably, however, a plurality of porous trays are provided and loaded with solids to be dried from the first stage in a batchwise continuous process. Accordingly, the material dried partially in the first stage may be

transferred to a first tray in portions and retained on the tray for a period sufficient to permit the second stage of the drying process to proceed. The ratio of capacities for the operative quantities between the primary and secondary chambers is suitably in the order of between nine and eighteen and preferably approximately twelve.

Preferably, five or six respective operative quantities are downloaded by the transfer means from the primary chamber and retained on the or each tray. Suitably each download is deposited on the previous download, so that slightly moister material is on the top, which is exposed to the driest air. A second tray is provided for receiving a like number of portions downloaded from the first stage whilst the material on the first tray is retained in the second portion for the second stage of the drying process. Suitably, the second stage of the drying process removes most of the remaining moisture which is typically more difficult to remove than the moisture removed in the first drying stage.

Once the material in the first tray has been dried, it is removed from the drying apparatus and a fresh first tray is inserted to receive material. Suitably, the fresh first tray receives 5 or 6 portions from the first stage after the second tray has been loaded, and the process is repeated by swapping the downloading from one tray to the other. Additionally, the first stage is preferably replenished with material to be dried after downloading each portion to the second stage. Preferably, each portion constitutes substantially all of the material in the first stage.

Thus, the dried material may be packed or packaged from the tray removed from the drying apparatus and the tray may be re-used. Alternatively, the trays may be provided in a stack of trays, and the first download deposited onto the lowest tray in the stack, and then for each subsequent download, another tray added to the stack above the previous tray and the downloaded material deposited onto the most

recently added tray.

It is also preferred that the drying apparatus include fluid temperature adjustment means for raising and/or lowering the temperature of the drying medium fluid passing around and through the drying apparatus. For example, the fluid may be cooled by a refrigeration system and heated by a heating system. The drying medium is suitably supplied to the drying chambers at or above ambient temperature and any dehumidifying is performed on the medium which is exhausted to atmosphere to recover process energy. This alleviates the risk of contaminating the drying medium with microbial conmtamination which occurs on surfaces made damp by a dehumidifying action.

Suitably, the drying medium is a gas and the fluid transport means is a blower for recirculating and discharging the gas through and from the drying apparatus. Accordingly, the dehumidifying system lowers the temperature of the gas in such manner as to remove moisture therefrom, and the gas is subsequently heated with the recovered process energy to a temperature suitable for drying the solids in the drying apparatus. Preferably, the moisture is removed from the drying medium externally to the primary and secondary chambers.

In another aspect, this invention resides broadly in drying apparatus including first and second drying stages through which material to be dried may be passed in a drying medium and characterised in that the residence time for material passing through the second drying stage is much greater than the residence time for material passing through the first drying stage. The ratio of residence times is suitably in the order of between nine and eighteen and preferably approximately twelve.

In another aspect, this invention resides broadly in a method of drying a material including the steps of:-

providing drying apparatus as hereinbefore described;

introducing the operative quantity of material into the primary chamber;

passing the drying medium through the primary chamber to remove some of the moisture from the material therein;

transferring the material from the primary chamber to the secondary chamber and charging the primary chamber with a fresh operative quantity of material;

passing the drying medium through the secondary chamber to remove the remainder of the moisture to be removed from the material and through the primary chamber to remove some of the moisture from the fresh operative quantity of material therein;

operating the appaatus until said plurality of operative quantities of material are charged in the secondary chamber and the desired residence time of material in the secondary chamber is achieved.

The operative quantity may be constituted by a batch of material or alternatively by a time rate of flow of material. Additionally, the operative quantity may be a rate of flow for one drying chamber and a batch for the other drying chamber.

Preferably, the material to be dried is a discrete solid which may fluidized by circulating air. The fluidized bed may be adapted to receive the material at one end of the fluidized bed and transfer partially dried material at the other end of the fluidized bed due to the fluidizing action of the recirculating air to the secondary drying chamber. Accordingly, the fluidizing action constitutes the transfer means operable to transfer the material from the primary drying chamber to the secondary drying chamber. Suitably, the fluidizing action permits the material to flow substantially like a fluid whereby the discrete solid forms a substantially horizontal top face such that it flows over a weir to the secondary drying chamber. Alternatively, a rake assembly or blower arrangement may be provided to transfer

material from the top of the fluidized bed to the secondary drying chamber. Alternatively, a spouted bed may be used in the primary chamber and a portion of the material spouted may be transferred to the secondary chamber. It will be appreciated that the fluidized bed may include a spout portion for spouting the material to be transported to the secondary chamber.

Preferably, the partly dried material is transferred to the secondary drying chamber through transfer means in discrete portions even though the fresh incoming material may be provided continuously.

For the continuous operation embodiment, lower level weirs extending upward partly through the thickness of the fluidized bed are provided across the fluidized bed intermediate the feed and the discharge to prevent denser material from short circuiting across the fluidized bed.

For some materials being dried, the partially dried material exhibits a much reduced density compared with non-dried material, and the transfer means may be adapted to blow partially dried material buoyed by the draught of the drying medium.

In another aspect, this invention resides broadly in a method of drying a material including:-

introducing the material into a primary drying chamber;

passing the material through the primary drying chamber at a rate sufficient to remove moisture which is easily removed from the material;

passing the partially dried material from the primary chamber to a secondary drying chamber;

passing the partially dried material through the secondary drying chamber at a rate sufficient to remove the remainder of the moisture to be removed from the material;

passing the dried material from the secondary drying chamber as dried material, and

passing a drying medium across the product in the

secondary drying chamber and the primary drying chamber in substantially counter-current direction to the material passing from the primary drying chamber to the secondary drying chamber.

The drying medium may be a liquid into which moisture from the material to be dried is absorbed, but preferably the drying medium is a gas, such as air. Other gases may be used, such as nitrogen, carbon dioxide, oxygen, sulfur dioxide or such like, or a mixture of gases if desired. Additionally, the air or other gas may be enriched or modified by the addition of one or more gases, vapours and/or aerosols, and may be used to effect treatments other than, or in addition to, the drying of the material.

The drying medium is preferably recirculated, but bled and replenished with fresh drying medium. Preferably, the drying medium is replaced at a dilution rate sufficient to prevent the build up humidity, contaminating organisms, and/or other undesirable effects. It is also preferred that the incoming air is heated, and the outgoing air is chilled to recover the heat therefrom.

It is believed that significant energy recovery may be effected due to the amount of energy transferred into the moisture in vapour phase which may be recovered both as sensible heat in lowering the temperature of the water and/or water vapour and as latent heat from the change of phase from water vapour to water. Suitably, the solid dried by the drying apparatus of this invention is stored in cold storage operated synergistically with the heat recovery system of the drying apparatus.

The heat source for heating the incoming air may be electrical, combustion heated or such like, but preferably, a waste heat source is used, such as a low grade heat source for example from refrigeration in another area of a food processing plant. Preferably, the incoming air is heated to a temperature of between 38°C and 42°C, and more preferably,

to a temperature of 40°C.

Additionally, it is preferred that the recirculating air is heated to a temperature sufficient to substantially disable contaminating organisms. Suitably, the recirculating air is passed over a condenser heated to a temperature of 60°C to 65°C, and the exiting air is passed over an evaporator chilled to a temperature of between -6°C to -2°C, but more preferably to a temperature of -5°C.

It is also preferred that the heat recovered from chilling the outgoing air be used to heat the incoming and/or recycled air.

In order that this invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a typical embodiment of the invention and wherein:-

FIG. 1 is a side view of a drying apparatus with side panelling removed;

FIG. 2 is a top sectional view through section 2-2 of the drying apparatus of FIG. 1;

FIG. 3 is an end sectional view through section 3-3 of the drying apparatus of FIG. 1;

FIG. 4 is an end sectional view through section 4-4 of the drying apparatus of FIG. 1;

FIG. 5 shows a sectional diagrammatic view of transfer means for the drying apparatus of FIG. 1;

FIG. 6 is a side view of an alternative drying apparatus with side panelling removed;

FIG. 7 is a top sectional view through section 7-7 of the drying apparatus of FIG. 6;

FIG. 8 is an end sectional view through section 8-8 of the drying apparatus of FIG. 6, and

FIG. 9 is an end sectional view through section 9-9 of the drying apparatus of FIG. 6.

In FIGS. 1 to 5, like parts have the same reference numerals as in FIGS. 6 to 9.

Referring to FIGS. 1 to 5, a drying apparatus 10 includes an insulated housing 11 having a pair of side walls 13, a pair of end walls 16, a top wall 15 and a base wall 14 arranged substantially to form a rectangular prism. The insulated housing 11 is mounted on a pair of mounting skids 12 underneath the base wall 14.

The insulated housing 11 has an end access 17 and a rear access 27 in respective ones of the end walls 16, the rear access 27 being in a rear wall 29. Each side wall 13 has a side access 18 and the top wall 15 has a top access 19. The top access 19 may include a top hatch for entry of material to be dried.

Within the housing 11 there is also provided a transverse internal wall 26 extending between the side walls 13 and the top wall 15 and base wall 14. Additionally, an internal wall 25 extends across the drying apparatus 10 between the side walls 13 substantially parallel to the top wall 15 and base wall 14, and includes a pair of internal apertures 39.

A blower 22 is provided in the drying apparatus 10 between the transverse internal wall 26 and the end access 17 which define a blower chamber 28. A plenum chamber 23 is provided beneath the internal wall 25 and between the transverse internal wall 26 and the rear access 27, and communicates with a blower discharge 41 for the blower 22.

Above the internal wall 25 there is a first drying chamber 20 and two second drying chambers 21 divided from the first drying chamber 20 by a pair of oblique panels 24.

A tray support 37 is provided in each respective second drying chamber 21 between the transverse internal wall 26 and the rear wall 29 and displaced above the internal wall 25 but beneath the respective oblique panels 24. A tray 30 may be provided on each tray support 37 to receive material from the first drying chamber 21.

In an alternative drying apparatus 40 shown in FIGS. 6

to 9, the trays 30 and tray supports 37 are substituted by a pair of conveyor belts 35. The belts 35 are porous to permit air to pass therethrough in a similar fashion to the trays 30 on the tray supports 37. The trays are perforated to 40% open area.

A fluidized bed 36 is provided in the first drying chamber 20 by providing a porous support 38 having series of apertures in the base wall of the first drying chamber 20 which separates it from the plenum chamber 23. The porous support has perforations to provide a 10% to 13% open area. The oblique panels 24 diverge upwardly so that the fluidized bed 36 is narrower at its base than at its top. The rear wall 29 also has an evaporator 31 mounted therein and the transverse internal wall 26 has a corresponding condenser 32 mounted therein. The side walls 13 include a plurality of pre-heaters 33 for heating air received into the second drying chamber 21.

The blower 22 when in operation recirculates air from the plenum chamber 23 and upwardly through the fluidized bed 36 and into the first drying chamber 20. Some of the air received into the first drying chamber 20 is recirculated through the condenser 32 whereupon it is raised in temperature and the remainder of the air received from the blower 22 is discharged through the evaporator 31 which chills the air exiting the drying apparatus 10.

In order to replenish the quantity of air being discharged through the evaporator 31, incoming air is preheated through the pre-heaters 33 which direct the incoming air through the second drying chamber 21, through the tray supports 37 or belts 35 which are porous, and into the blower chamber 28 through the internal apertures 39.

The plenum chamber 23 is of a volume sufficient to permit an even distribution of the air received from the blower 22 to pass upwardly through the fluidized bed 36 to provide a substantially even fluidizing action across the

fluidized bed 36.

Referring to FIG. 5, the oblique panels 24 between the first drying chamber 20 and the second drying chambers 21 each include a hinged portion 50 which is pivoted about respective pivots 51 to perform a download of material from the first drying chamber 20 to a respective one of the drying chambers 21. The hinged portion 50 is pivoted in the direction of arrows 55 as the case requires to a position shown in dotted outline.

In a drying apparatus having a length of approximately 6.1 metres, a width of approximately 3 metres and a height of approximately 4.1 metres, the blower 22 is preferably of a capacity of 10,000 litres per second of air at standard temperature and pressure.

The evaporator 31 and the condenser 32 are arranged such that approximately 1/3 of the volume of air produced from the blower 22 is directed through the evaporator 31. For this purpose, baffles or the like flow restrictors are provided in association with the evaporator 31 and the condenser 32 to adjust the throughput in order to achieve the desired ratio of air flows.

In a preferred embodiment, the plenum chamber 23 has a capacity of 10 times the volumetric flow rate of the hole through the fluidized bed 36. The fluidized bed preferably has apertures which are 1/8 the depth of the bed with an open area of 10% to 12% of the fluidized bed.

Preferably, the pre-heaters 33 are condensers which utilise waste heat. The preferred embodiment has the incoming air heated to a temperature of between 38°C and 42°C or more preferably to a temperature of 40°C.

The air exiting the evaporator 31 is preferably lowered to a temperature of -5°C and the recycled condenser 32 preferably heats to a temperature of 60°C to substantially pasteurize the surfaces of the condenser.

The air pressure across the fluidized bed is from 80 mm

to 180 mm or preferably 150 mm water pressure and the static pressure on the trays 30 or belts 35 is preferably 50 mm water gauge. Preferably, there is an 80 mm water gauge pressure drop across the trays 30 and tray supports 37 or belts 35.

In a preferred embodiment, the residents time of material being dried on the trays 30 or belts 35 is 18 hours and the residents time of the material in the fluidized bed is of the order of 90 minutes. Suitably, the depth of material on the trays 30 or belts 35 is 400 mm to 600 mm.

It is believed that evaporative cooling in the fluidized bed and recovery of the heat exiting through the evaporator 31 is approximately half of the heat input through the pre-heaters 33.

The material to be dried may be any material as hereinbefore described. It is believed that the dryer of the present invention is suitable for drying such food substances as carrot, capsicum, potato, onion, celery, garlic etc and it also is suitable for leaf lines such as lettuce, spinach, tobacco leaf and such like. Additionally, a radiant disinfection means may be provided in the plenum chamber 23 such as a UV light source or the like.

It is believed that the use of a drying apparatus of the present invention takes advantage of the drying characterises of food substances which have a falling drying rate when received into the drying apparatus and processed by the fluidized bed and a constant drying rate which is processed on the trays 30 or belts 35.

In use, food of a suitable size is introduced continuously to the drying apparatus 10 through a feed inlet in the roof 19 near the end closer to the rear wall 29. The feed is fluidized by the action of the blower 22, whereby the feed flows towards the transverse internal wall 26. As the level of fluidized solid increases, it reaches a level which triggers the hinged portion 50 to open an download material

onto the trays 30.

5 or 6 downloads are preferred, each with an interval of 1½ hours so that, for 6 downloads, the tray on one side will take 9 hours, and a further 9 hours allow for the remainder of the moisture to be removed whilst the hinged portion 50 is opened at suitable intervals to the other side to download to the other tray 30. Preferably, the hinged portion 50 is opened for a time sufficient to permit substantially all of the material in the first drying chamber 20 to be downloaded to the respective second drying chamber 21.

In the case of the alternative drying apparatus 40, an excess of partially dried food flows over a weir and onto each of the conveyor belts 35. The residence time in the fluidized bed is of the order of 1½ hours.

Partially dried feed received onto trays 30 is removed after a suitable drying period, such as 18 hours, or the respective belts 35 are slowly transport the drying material along the second drying chamber 21 towards the rear wall 29, whereupon it exits the drying apparatus 40 to a hopper, bagging machine, or further processing as desired. The process is preferably automated and either continuous or batchwise continuous. Alternatively, the respective belts 35 may be designed to deposit the dried material into a hopper or surge bin inside the drying apparatus 10.

The drying apparatus of this invention is directed towards effecting the first stage of the drying process in as short a time as possible to minimize the possibility of deterioration and/or contamination of the product to be dried. It is believed that this is achieved by utilising a large volume of high velocity air in contact with the product to be dried. It is believed that the product is dried in the first stage substantially in the "falling rate" portion of the drying curve, with the second stage of the drying process substantially within the "constant rate" portion of the drying curve.

Additionally, the drying apparatus of this invention is arranged such that the drying medium received into and recirculating within the apparatus is not exposed to a surface at or less than the dew point of water before the drying medium has been contacted with the product.

It will of course be realised that the above has been given only by way of illustrative example of the invention and that all such modifications and variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of the invention as claimed in the following claims.

-- CLAIMS --

1. Drying apparatus including:-

a primary drying chamber for receiving an operative quantity of material to be dried;

a secondary drying chamber for receiving material from said primary chamber, said secondary chamber being able to contain a plurality of operative quantities of material from said primary chamber;

transfer means for transferring the material from the primary chamber to the secondary chamber;

supply means for supplying a gaseous drying medium through said drying chambers, and

heating means for heating the drying medium supplied to said drying chambers.

2. Drying apparatus as claimed in claim 1, wherein said primary drying chamber is a fluidized bed chamber.

3. Drying apparatus as claim 1 or claim 2, wherein said supply means circulates an air supply from an air inlet successively through said secondary drying chamber and said primary drying chamber.

4. Drying apparatus as claimed in claim 3, wherein said supply means includes a recirculating supply path through said primary chamber.

5. Drying apparatus as claimed in claim 3 or claim 4, including recovery means for recovering heat from the gaseous drying medium discharged externally of said drying chambers, and said recovery means supplying heat to said heating means.

6. Drying apparatus as claimed in claim 5, wherein said heating means is disposed in said air inlet.

7. Drying apparatus as claimed in any one of the preceding claims, wherein said supply means includes a pump for fluidizing the material in said primary chamber and wherein the inlet to said pump communicates with said secondary chamber.

8. Drying apparatus as claimed in any one of the preceding claims, wherein said secondary drying chamber contains a plurality of holding stations for holding respective batches of material from the primary chamber.

9. A method of drying a material including the steps of:-

providing drying apparatus as claimed in any one of the preceding claims;

introducing said operative quantity of material into said primary chamber;

passing the drying medium through said primary chamber to remove some of the moisture from the material therein;

transferring the material from said primary chamber to said secondary chamber and charging said first chamber with a fresh operative quantity of material;

passing the drying medium through said secondary chamber to remove the remainder of the moisture to be removed from the material and through said primary chamber to remove some of the moisture from the fresh operative quantity of material therein;

operating the appaatus until said plurality of operative quantities of material are charged in the secondary chamber and the desired residence time of material in the secondary chamber is achieved.

10. A method as claimed in claim 9, wherein said operative quantity is constituted by a batch of material.

11. A method as claimed in claim 9, wherein said operative quantity is constituted by a time rate of flow of material.

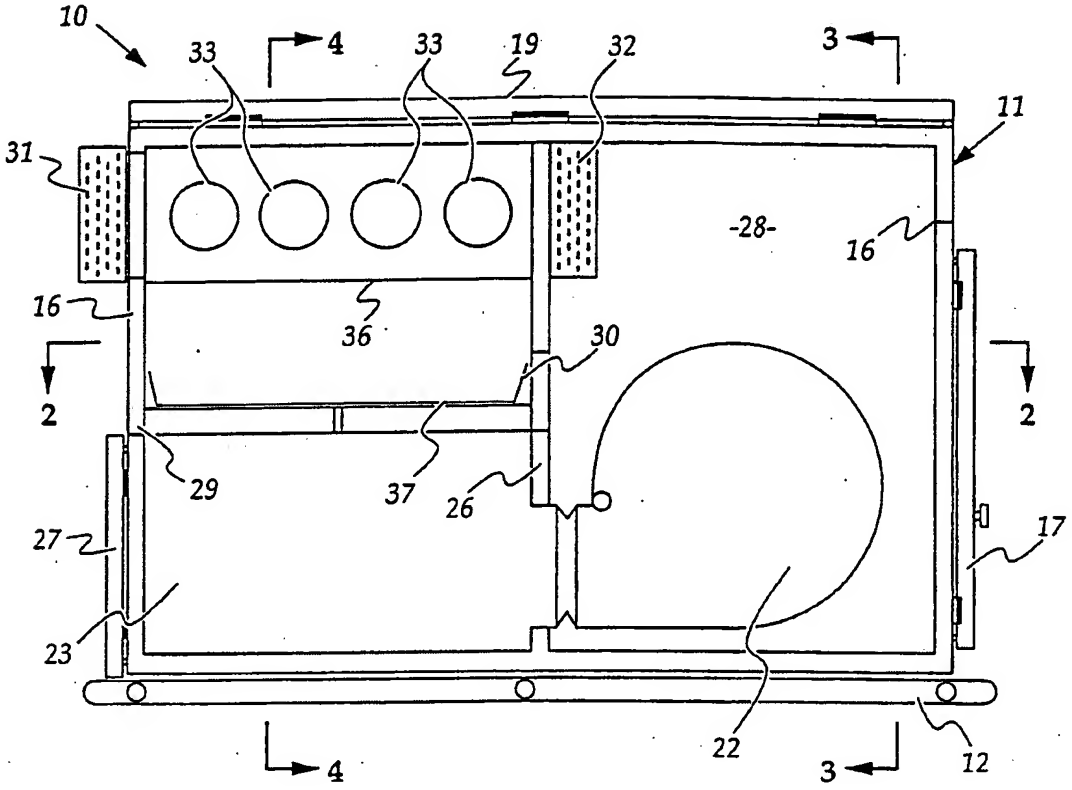
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Fig. 1.

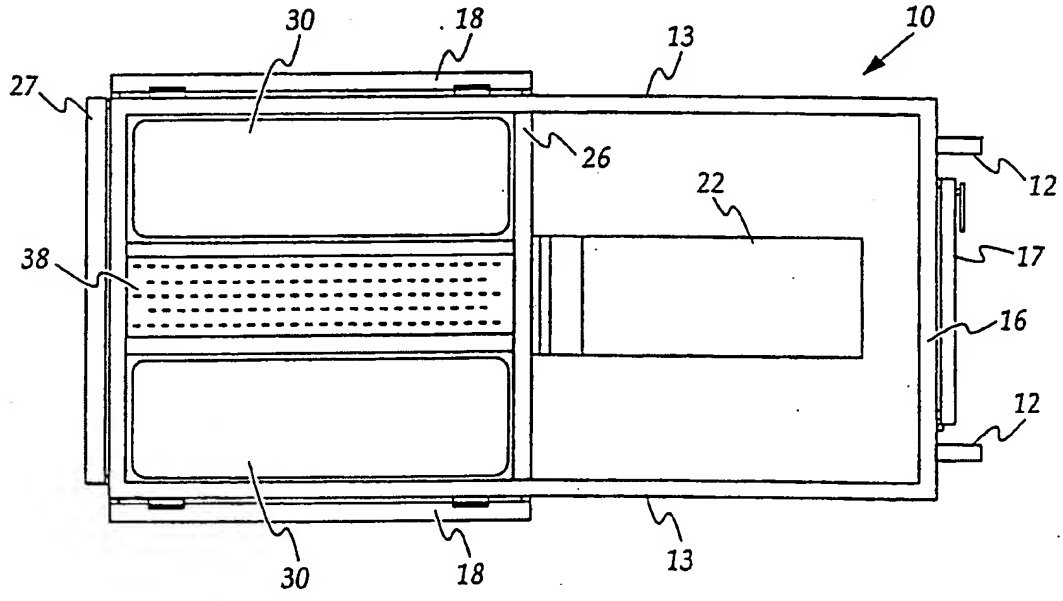
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Fig. 2.

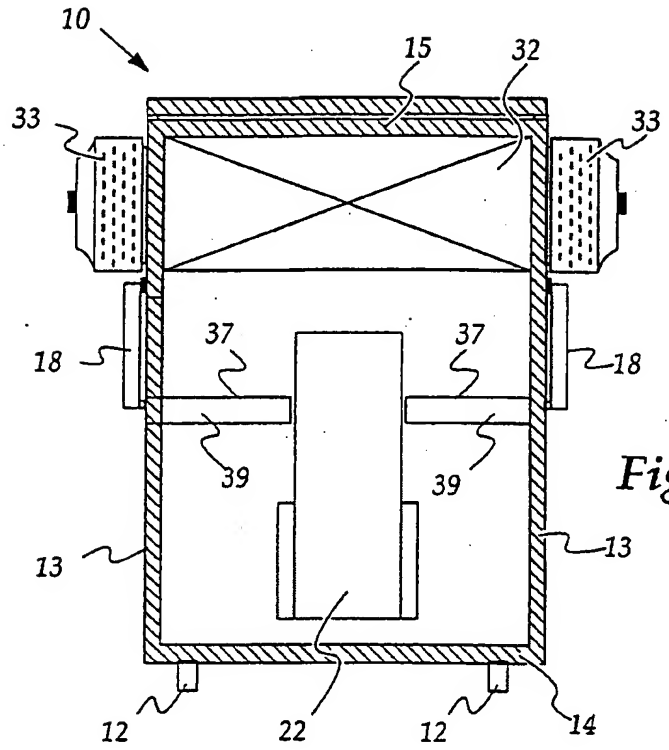
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Fig. 3.

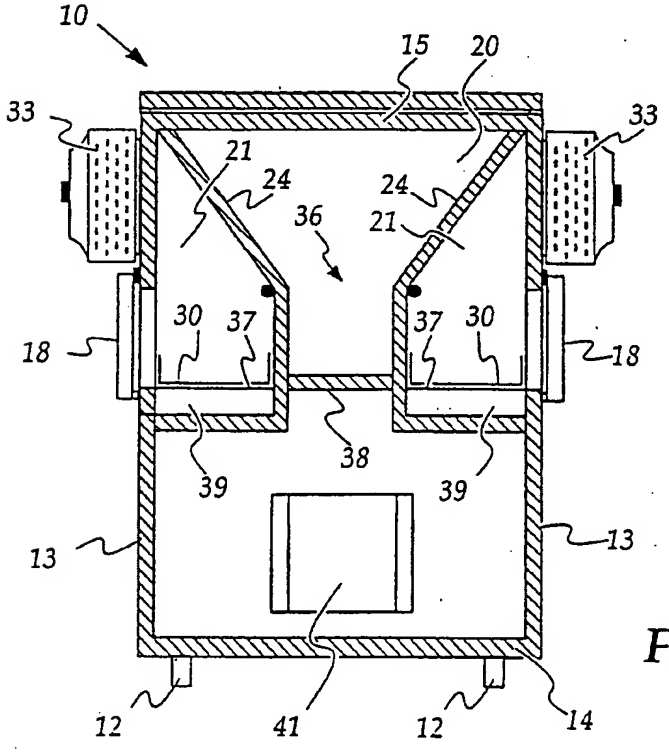
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Fig. 4.

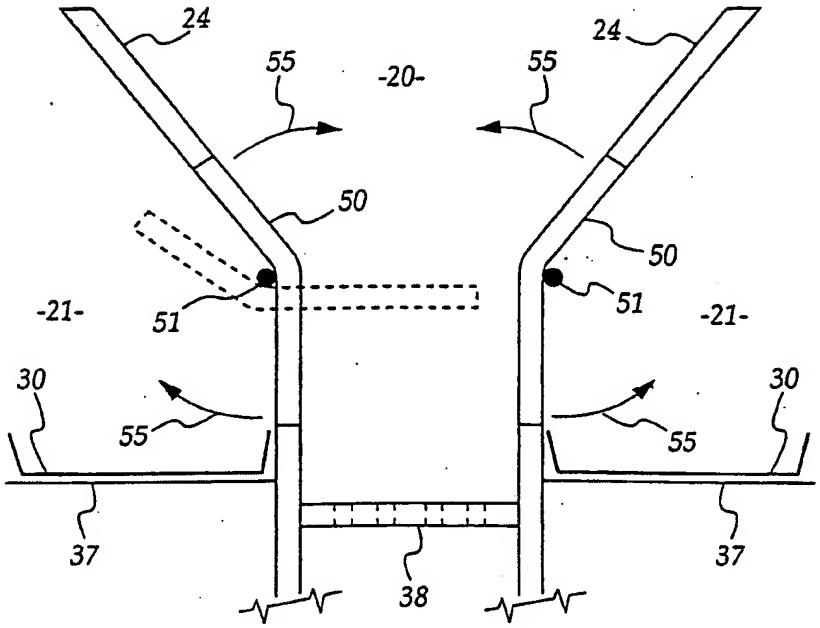

Fig. 5

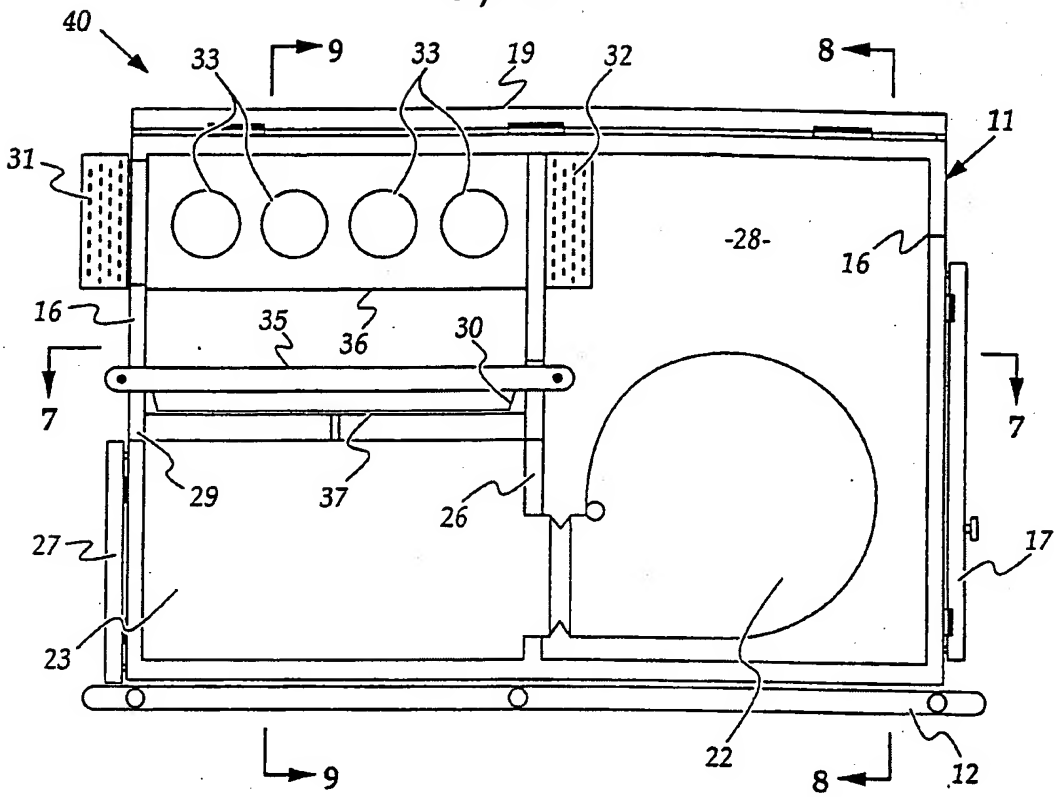
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Fig. 6.

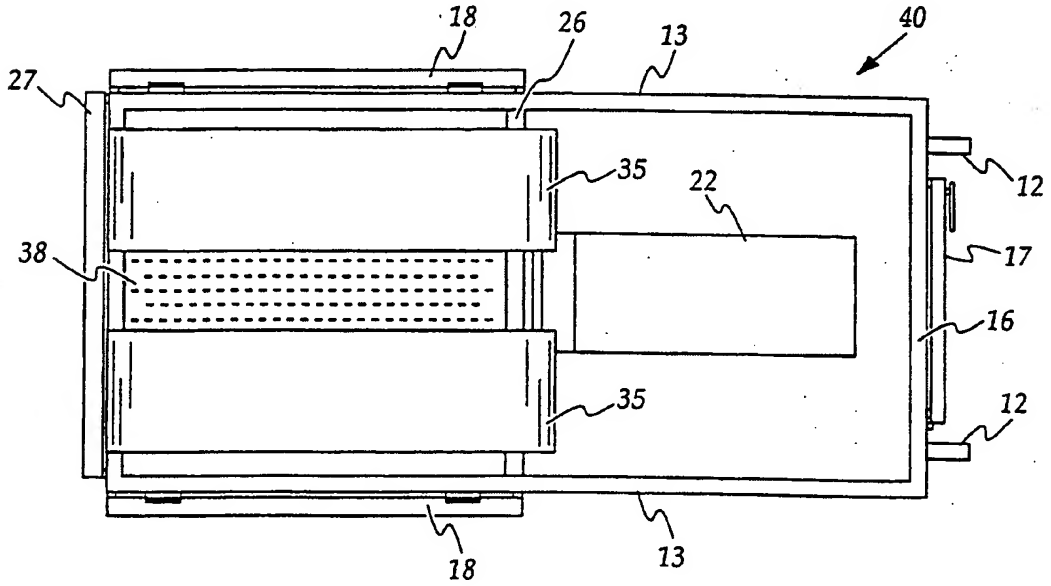
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Fig. 7.

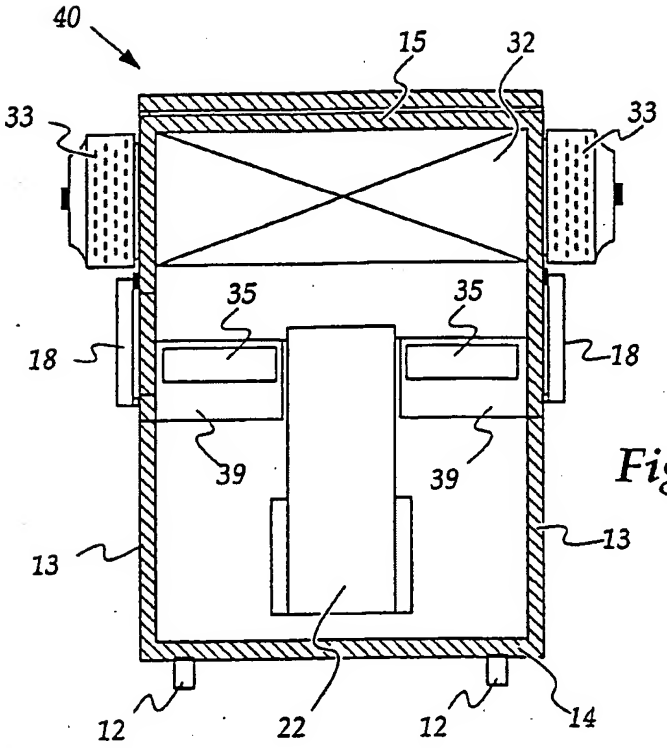
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Fig. 8.

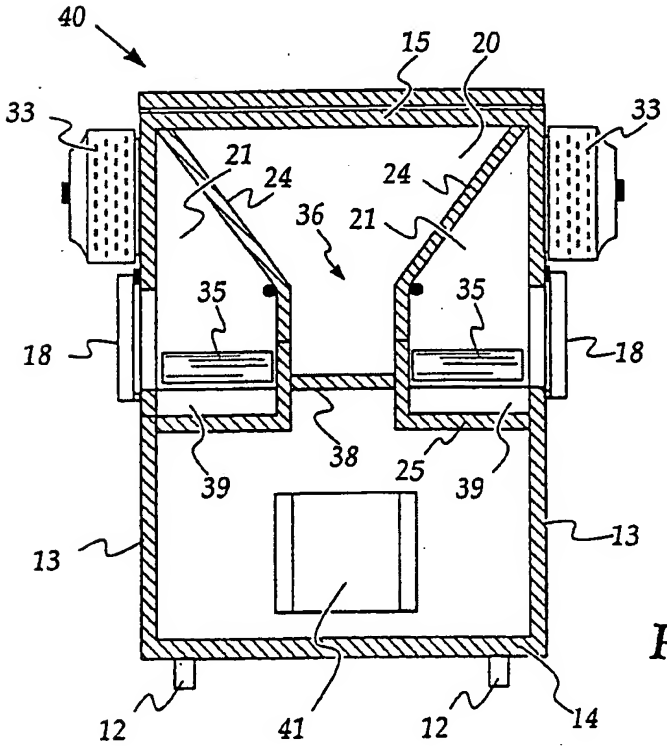
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Fig. 9.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 94/00707

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.[6] F26B 20/00, 7/00, 3/06 // A23B 7/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC F26B 20/00, 7/00, 3/06, 3/08, A23B 7/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC as above

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	US,A, 4492040 (JENSEN et al.) 8 January 1985 (08.01.85) see figure 1	1-11
X	US,A, 3740861 (MYERS) 26 June 1973 (26.06.73) See figure 1	1-11
X	US,A, 3589027 (DUZAN et al.) 29 June 1971 (29.06.71) See figure 1	1-11

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 March 1995 (02.03.95)	8 Mar 1995 (8.3.95)
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No. 06 2853929	Authorized officer P. WEST Telephone No. (06) 2832108

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	US,A, 3513560 (LAMARE) 26 May 1970 (26.05.70) See figures.	1-11
X	DE,A, 4205619 (GEA CANZLER GMBH) 26 August 1993 (26.08.93) See figure 1	1-11
X	FR,A, 2425043 (GOURMELEN) 4 January 1980 (04.01.80) See figure 1	1-11
P,X	Patent Abstracts of Japan, C1213, page 30, JP,A, 6-70680 (KAWASAKI KIKO PTY LTD) 15 March 1994 (15.03.94)	1-11

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Member
US 4492040	DK 4964/80
US 3740861	BE 768543, DE 2129499, FR 2097927, GB 1284380, NL 7108259
US 3589027	GB 1233112
US 3513560	BE 711496, CH 489766, DE 1729272, GB 1176746, NL 6802896
DE 4205619	
FR 2425043	
JP 6070680	
	END OF ANNEX